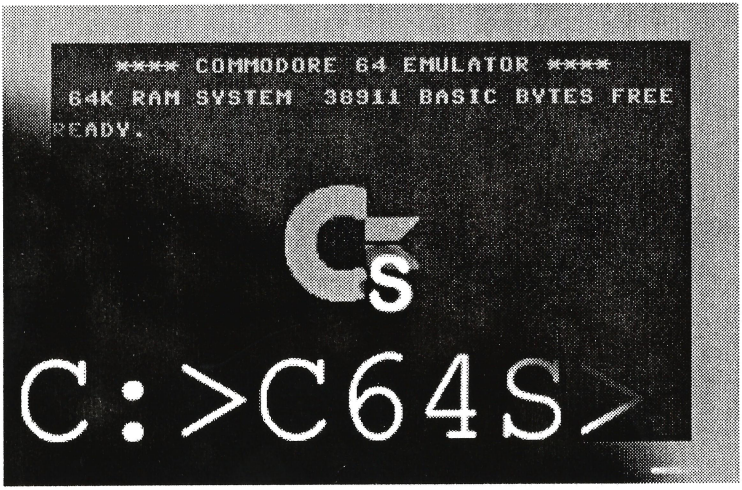
C64S Commodore 64 Emulator



User's Manual

by
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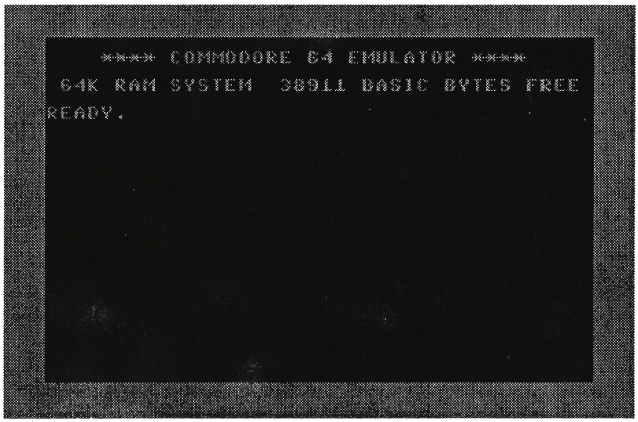
INTRODUCTION

Welcome (back) to the world of the Commodore 64. This powerful software emulator will allow you to run most of the original Commodore 64 software on your PC. C64S is an evolving program and will provide more and more compatibility as time progresses.

Included with your C64S Emulator Package is: this manual, a 4-foot cable used to connect your Commodore 1541 or 1571 disk drive (or compatibles) to your PC's parallel port, a high-density 3.5" diskette containing the emulator and some sample files and your warranty/product registration card.



This manual is also available on-line on our WWW server. http://www.seattlelab.com/

Seattle Lab Inc. is the authorized distributor of C64S Commodore Emulator throughout the world, with the exception of Germany.

This manual was printed in the United States of America.

INSTALLATION PROCEDURES

Installing C64S takes just a few moments. Insert the 3.5" floppy into your disk drive, it is recommended at this time that you make a backup copy. Log onto the drive (Usually `A:` followed by `ENTER`) then type `INSTALL` and press `ENTER`.

```
C>A:
A>INSTALL
```

The installation program will copy and unpack the files to your hard disk (usually to drive C and the directory \C64S). Once this process is complete, it's time to configure C64S. Log onto the drive and the directory where you installed C64S. Then type `CONFIG` and press `ENTER`.

```
C>CONFIG
```

The configuration program will autodetect the presence of soundcards, analog joysticks, and parallel (LPT) ports. Some users may have many add-on cards installed in the computer in which case the autodetection procedures may fail or even crash the computer. If you notice any such trouble, reboot and log onto the C64S drive and directory again, this time type `CONFIG -S`. This will disable the autodetection procedures. If you continue to have problems, write down any error messages that appear, note your hardware (CPU type, RAM, Operating System, CMOS type, CMOS version, CMOS date, etc.), and call our Technical Support number at (206) 402-6003. Alternately you may e-mail us at lab@seattlelab.com.

Running C64S under Windows, Windows NT, Windows 95 or OS/2:
Under Windows, Windows NT or OS/2 it is advised that you run C64S with sound output disabled and if you are using a PC joystick to set it to "compatible". External CBM devices are unavailable under these operating systems. It is not recommended to use C64S from any Windows or OS/2 environment. Under Windows 95, it is advised that you change C64S's CPU emulation to 220% or higher or run it in "MS-DOS mode".

CONFIGURATION GUIDE

Sound Output	C64S can autodetect Gravis Ultrasound, Sound Blaster (or true compatibles) and Pro Audio Spectrum soundcards. If the sound output is set to autodetect, the priority of selecting sound cards is: GUS, PAS, SB, and PC Speaker. If the configuration program fails to detect your soundcard's port, try setting it manually in the configuration screen. Note that C64S can autodetect and use PAS soundcards **only** if the MVSOUND.SYS device driver is loaded. Setting sound synchronization to High enables the C64S to reproduce digitized speech and other digital effects, whereas Low setting saves some CPU time.
Analog Joysticks	If this option is set to autodetect, C64S will automatically determine the number of PC joysticks that are connected to your PC. Setting this option to 1 or 2 joysticks will force C64S to read the selected number of joysticks. In addition, C64S provides two methods of scanning joysticks. Compensating mode takes less CPU time but might fail with some joysticks or newer "speed compensating" game ports. Compatible mode will work with all joysticks. It is recommended that you try compensating mode first.
Video Mode	C64S works in two video modes, the default is a special VGA extended mode which is 368 by 240 pixels with 16 colors. Some VGA cards and LCD laptop displays cannot use this special mode, in which case set this option to compatible.
External Devices	C64S supports real-time communications with external CBM devices connected to the PC's parallel port. Setting use external devices must be set to *autodetect* or *yes* to use any external device. If you do not use any external devices you may set use external devices to *no* to speed up C64S's initialization routine. The same goes for External 1541 drive and External CBM printer settings. C64S can detect a printer as either device 4 or 5, and 1541 or compatible disk drives as devices 8 through 11. The lowest drive number not assigned to an external disk drive is assigned to be the emulated 1541 drive. The lowest printer device number not assigned to an external CBM printer is assigned to the PC's printer.
Parallel Port	This port setting is used for direct PC printer communication. Default setting is LPT1, but you may need to change this setting if you have more than one parallel port. If you try to assign a non-existing port, the selection will be marked as not available (N/A).
Tape/CBM IEEE Port	These port settings are used by the supplemental programs TAPEIO and COM1541 for Commodore 1541, 1571 and tape drive support. If you have only one available parallel port it will be autodetected.

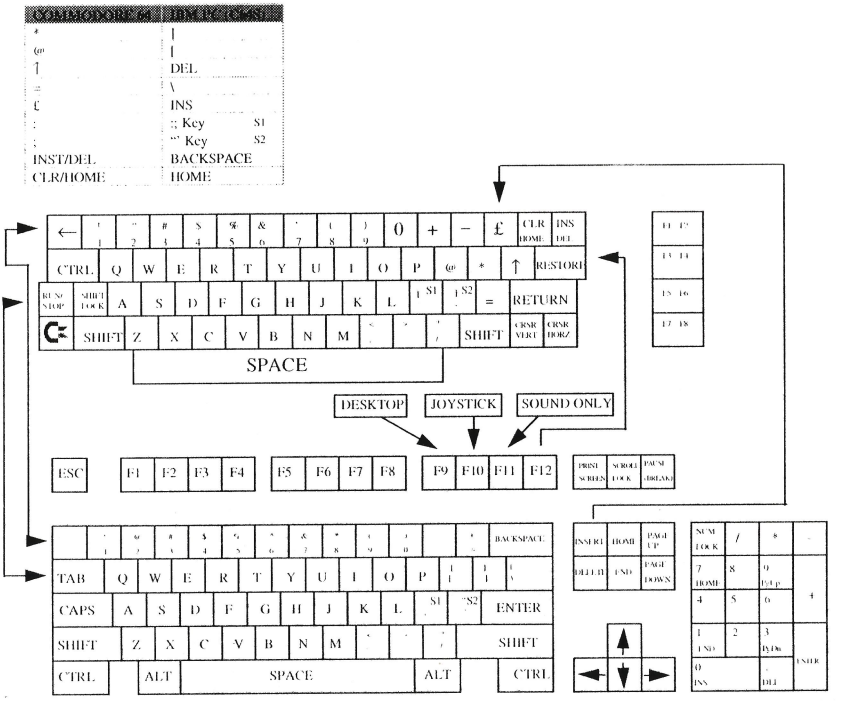
Please Note that if you are using the drive cable with a 1541 or 1571 disk drive in "real time," that the presence of a 'real' device 8 will cause the emulated drive to become drive 9. Some software is hard coded to use device 8. Use caution.

KEYBOARD LAYOUT AND SPECIAL FUNCTIONS

The Commodore 64 keyboard and the IBM PC keyboard have some important differences. While the numbers and letters are in the same place, some special keys, such as = and " are in different places. C64S attempts to emulate the original Commodore 64 keyboard layout as closely as possible. Hence `SHIFT-2` will yield quotes, pressing `[` will yield a `@` and so on.

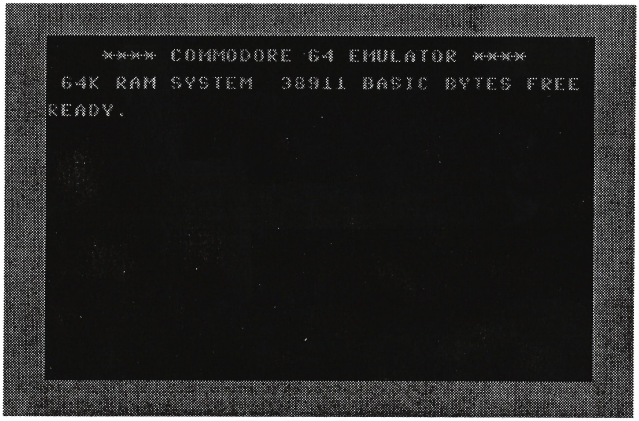
NOTE: Some IBM-style keyboards may have different sized enter keys and the \ key may be in a different spot.

Commodore 64S Emulator Key Reassignment Chart



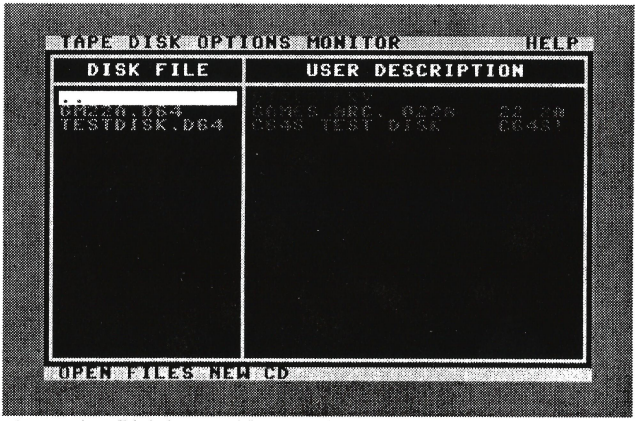
FIRST STEPS

This step by step introduction is here to help beginners use the emulator for the first time. Run the emulator by changing to the emulator's directory (if necessary) and typing in C64S and pressing ENTER.



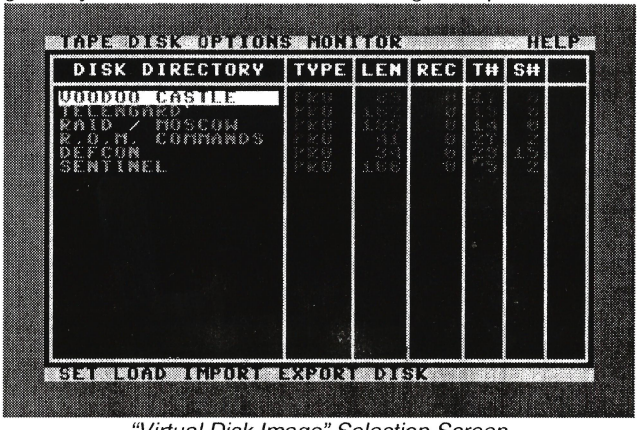
The First Screen

Press F9 to get to the emulator's special desktop. It works similarly to the old Commodore 64 enhancement products such as *The Final Cartridge*:



ALT-D shows the *Disk Image Menu* and ALT-T shows the *Tape Image Menu*

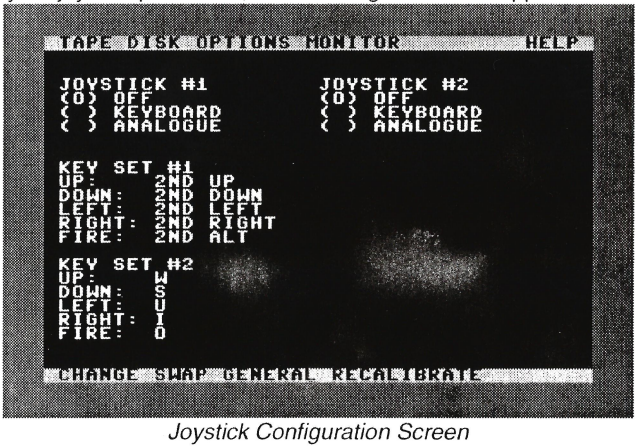
From these menus you can run programs that have been transferred from floppy or tape to virtual images on your PC hard disk. Select an image and press ENTER:



"Virtual Disk Image" Selection Screen

Select a program using the cursor keys and press L to load it. If you press ENTER instead of L you will return to the Commodore 64 screen with the disk image as the currently set disk in your *"emulated drive"*.

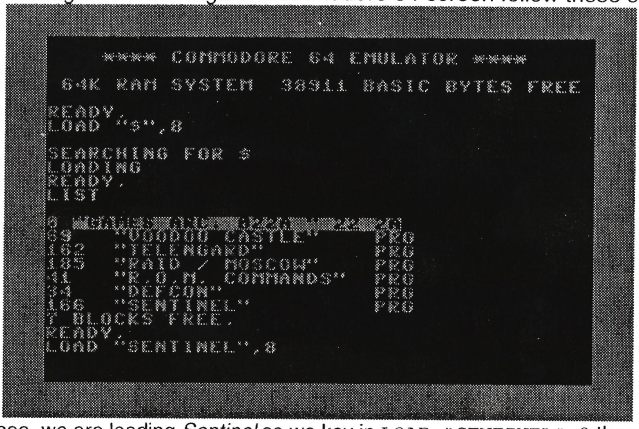
To configure your joystick press F10, the following screen will appear:



Joystick Configuration Screen

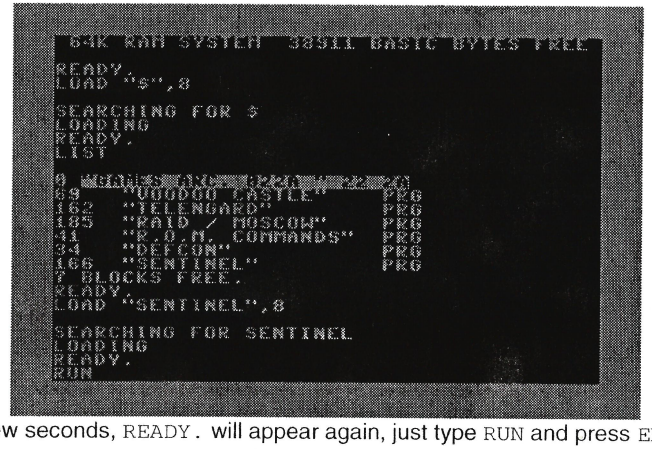
Joystick emulation is available both using keyboard keys and an IBM PC style analogue joystick. If you experience drifting problems be sure to *RECALIBRATE* your analogue joystick(s).

To load a disk image from the regular Commodore 64 screen follow these simple steps:



In this case, we are loading *Sentinel* so we key in `LOAD "SENTINEL",8` then `ENTER`.

NOTE: The quote key on the Commodore keyboard is `SHIFT-2`.



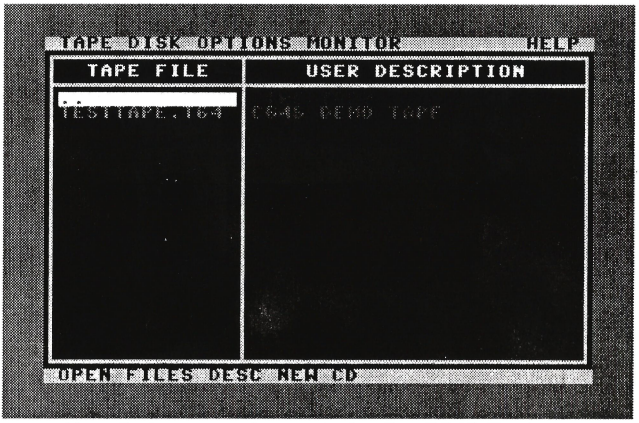
In a few seconds, `READY.` will appear again, just type `RUN` and press `ENTER`.

There are two types of programs in Commodore 64 DOS, programs that are "RUN" with the *`RUN`* command are always loaded with `,8`. Other programs are loaded with `,8,1` (e.g., `LOAD "DIGDUG",8,1`) and are either auto-executing or require a machine language address. (e.g., `SYS 32761`).

For more CBM DOS and CBM BASIC commands, see page 34.

EMULATOR DESKTOP

Pressing F9 at any time from the familiar Commodore screen (even from within a Commodore program), will open the C64S Emulator "Desktop". The desktop consists of multiple screens that allow you to manipulate the tape and disk images used in the emulator, you can change several emulation parameters and you can even monitor the emulated CPU and memory (both the C64 and the 1541 portion).



Your first screen when entering the C64S Desktop.
NOTE: Your collection of tape images may differ

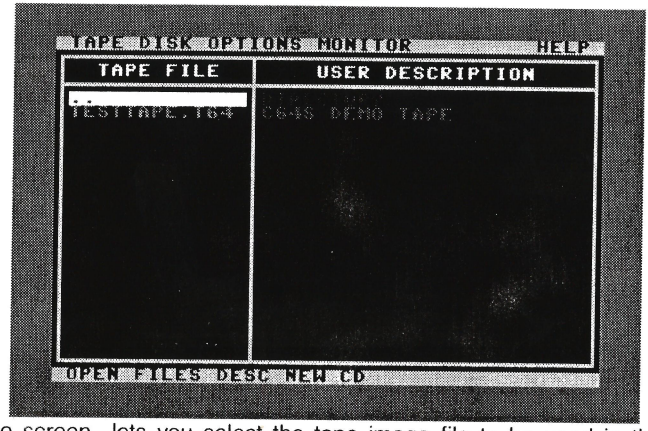
The top screen line represents the main menu. There are five main options: TAPE, DISK, OPTIONS, MONITOR and HELP. Press ALT to activate the menu then press the first letter of the option you use to use. (You may also hold down ALT and press the first letter at the same time.). Without the ALT sequence the lower menu is available also by pressing the first letter of each command option.

NAVIGATION

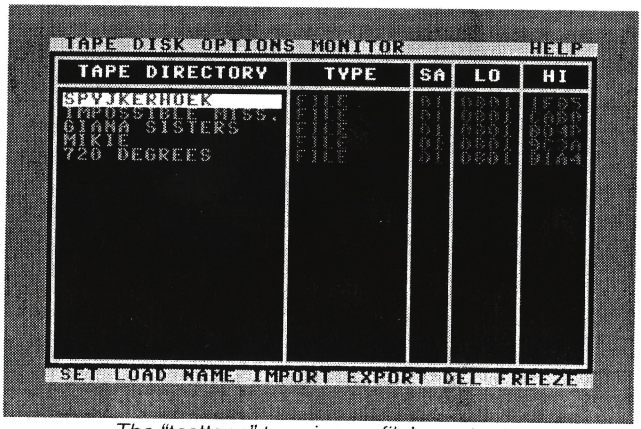
OPEN selects the image file (short cut: ENTER); FILES displays the directory for the image file (shortcut: RIGHT ARROW); DESC (*Describe*) lets you modify the user description field; NEW allows you to create a new disk or tape image file.

Pressing ENTER (e.g., OPENing) . . (described as "*DIRECTORY*") means you are going up a directory level, just as in MS-DOS. By the same token, pressing ENTER on a directory name (highlighted in green) will move you down one level to that directory. The CD option allows you to change MS-DOS drives.

TAPE



The tape file screen lets you select the tape image file to be used in the emulator. Move around with the arrow keys, press ENTER to select the tape or change the drive and/or directory.



The "testtape" tape image file's contents.

Tape images can contain one to ninety-nine files. Unlike tape drives on the original Commodore 64 (such as the Datasette), programs stored in this method load instantly. The only limitation is multi-file tape programs are not currently supported.

TAPE IMAGE MENU COMMANDS

The bottom of the tape image menu has seven commands available, here is a list of each one and what they do.

SET Set merely locks the emulator to that file, in that tape image. If you press ESC to return to the emulator and you simply type in LOAD that particular file will be loaded into the "Commodore 64"'s memory, ready to be RUN.

LOAD This command will reset the emulator, LOAD and then RUN the specified program.

NAME Allows you to rename the tape filename.

IMPORT Select the file from the MS-DOS file list and it will be added to the current tape image file. The MS-DOS file must be in one of two formats:

Standard CBM DOS "PRG" Format
PC64 .Pnn Format

EXPORT Saves the highlighted file to a PRG or P00 file in the MS-DOS file system. All other extensions default to PRG format. You cannot export to a tape image (T64) file.

DEL Deletes the highlighted file.

FREEZE Saves full emulator state to a file.
This is similar in function to the ISEPIC and FINAL CARTRIDGE image saves. When you load a freeze file, it will start automatically from the point where it was saved.

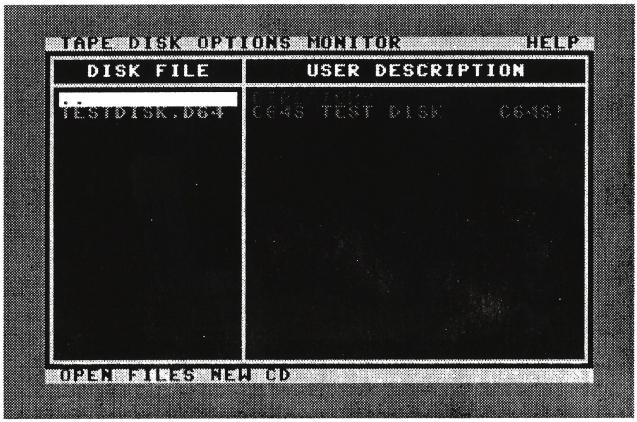
NOTE: This function is not yet standardized.

NOTES ON TAPE IMAGES

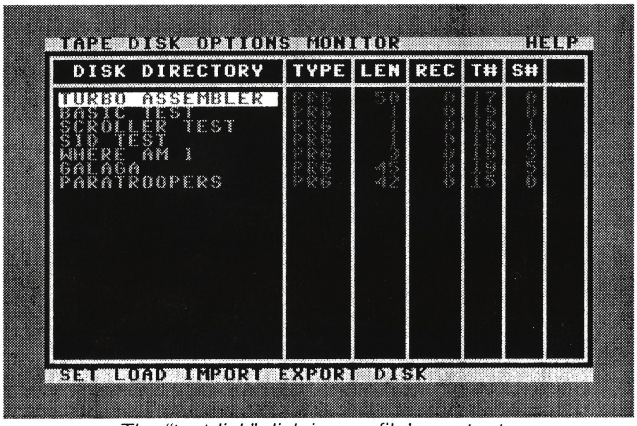
When saving a file, the emulator will always add a file to the end of the tape image, regardless of the position set (it will not overwrite anything).

Multiple tape programs are not yet supported by the emulator.

DISK



The disk file screen lets you select the disk image file to be used in the emulator. Move around with the arrow keys, press ENTER to select the disk or change the drive and/or directory.



The "testdisk" disk image file's contents.

Disk images represent all the sector data from a Commodore 1541-formatted diskette. All file types are supported. Multiple disk software is also supported.

The limit on the number files on a 1541-diskette is 144 files. That same limit applies to disk images.

DISK IMAGE MENU COMMANDS

The bottom of the tape image menu has seven commands available, here is a list of each one and what they do.

SET Activates this disk image as the "disk that's in the drive". Most uses during play will be for "insert map disk" or similar situations.

LOAD This command will reset the emulator, `LOAD` and then `RUN` the specified program.
NOTE: It will load the program ,8,1 in all cases.

IMPORT Select the file from the MS-DOS file list and it will be added to the current tape image file. The MS-DOS file must be in one of two formats:
Standard CBM DOS "PRG" Format
PC64 .Pnn Format

EXPORT Saves the highlighted file to a PRG file in the MS-DOS file system.

DISK Returns to the disk image selection menu (short cut: left arrow).

QUICK REFERENCE CBM DOS 2.6 COMMANDS

Loading Programs

BASIC PROGRAMS	`LOAD "filename",8` `RUN`	
AUTOLOADING	`LOAD "filename",8,1`	
MACHINE LANGUAGE	`LOAD "filename",8,1` `SYS #####`	##### is the entry point

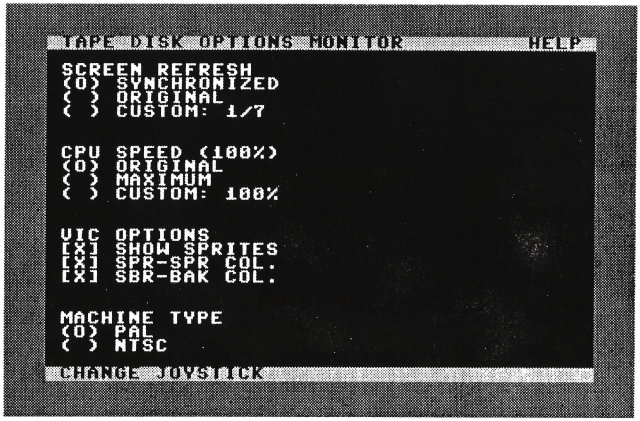
Saving Programs

SAVING A FILE	`SAVE "filename",8`	
REPLACING A FILE	`SAVE "@:filename",8`	

Listing a Directory

```
LOAD "$",8
LIST
```

EMULATOR OPTIONS



General Options

CHANGE

Changes the highlighted option. It either selects the highlighted radio button, changes the check box status or asks the user to edit the highlighted field. If the radio button list title is highlighted, change will cycle through the different settings.

JOYSTICK

Switches to the Joystick Configuration Screen.

SCREEN REFRESH

The Commodore 64 updates the on-screen picture 50 frames per second in PAL (European television standard) or 60 frames per second in NTSC (North American/Japanese television standard). The emulator must generate a lot of video data and transfer it to the VGA card very quickly. This is the most time-consuming part of the emulation. C64S allows you to control how much time to allow for this so slower PC's can increase the speed of the program by sacrificing video smoothness.

NOTE: If the video is too choppy some sprite collision detection in games may not function properly.

SYNCHRONIZED

Automatically synchronizes the screen refresh rate with the speed of your computer. It will autoselect the screen refresh rate between original refresh rate and the custom frame rate. This way you can limit the lowest frame rate. It is advised that you

SCREEN REFRESH (Continued)

input the custom frame rate between 1/3 and 1/10 and set the screen refresh to synchronized.

ORIGINAL

Selects original (Commodore 64) refresh rate (1/1)

CUSTOM

Selects custom refresh rate. 1/x means 1 out of x number of frames is displayed. 1/1 means each and every frame is displayed, 1/10 means only every 10th frame is displayed.

CPU SPEED

The Commodore 64's 6510 CPU runs at a fixed clock rate of around 1 MHZ. The emulator lets you control the CPU speed, which is useful in some applications. However, to achieve higher CPU speeds you will need a fast PC (80486/66 will run at 250%-450% speed). The percentage displayed in the parenthesis in the general option screen is the current estimated speed.

ORIGINAL

Tries to near original (100%) speed

MAXIMUM

Forces maximum achievable speed

CUSTOM

Sets the emulator to run at this speed (or below)

VIC OPTIONS

SHOW SPRITES

Controls the display of sprites (pointers, space ships, etc.)

SPRITE-SPRITE COLLISIONS

Controls the collision detect between sprites

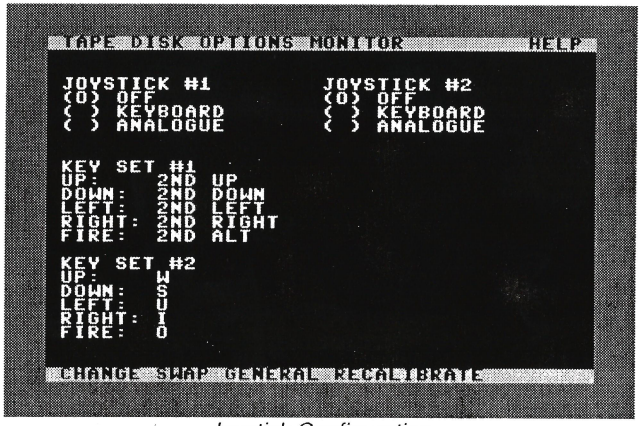
SPRITE-BACKGROUND COLLISIONS

Controls the collision detect between sprites and the background graphics

MACHINE TYPE

There were two major types of Commodore 64 machines manufactured for two different television standards: **PAL** (used in Europe) and **NTSC** (used in USA). Most programs will run fine with either setting, the emulator lets you switch to gain better compatibility. Try changing this setting when you notice on-screen garbage or music playing too quickly or too slowly.

JOYSTICK OPTIONS



Joystick Configuration

JOYSTICK 1 & 2

The Commodore 64 had two *digital* joystick ports (the same type used on the early videogame consoles such as the *Atari 2600*). Digital joysticks do not exist in the world of the PC so these need to be emulated. Most games used joystick port 2, but some used port 1. The rule of thumb is to try port 2 first.

OFF

Turns off emulation for selected port

KEYBOARD

Selects digital joystick emulation via user-defined keyboard keys. Key Set #1 is for emulated joystick #1 and Key Set #2 is for emulated joystick #2.

ANALOGUE

This option allows the C64S software to convert your analogue joystick's signals into digital joystick information for the C64 program.

KEY SET #1

Allows you to define the keys to use for emulated joystick port #1.
The default is the 4-cursor key cluster and the right ALT button.

KEY SET #2

Allows you to define the keys to use for emulated joystick port #2.
The default is set to W and S for vertical movement, U and I for horizontal movement and the O key for fire.

CHANGE

Changes the highlighted option. It either selects the highlighted radio button, changes the check box status or asks the user to edit the highlighted field. If the radio button list title is highlighted, change will cycle through the different settings.

SWAP

Toggles all of your settings for one port to the other and vice-versa

GENERAL

Switches to the General Options Screen.

RECALIBRATE

For analogue joysticks only, allows you to re-establish the center position. Use this option if your joystick is "drifting."

NOTE: As on the original Commodore 64, some of port 1's functions are handled by the keyboard handler. Pressing directions on a port 1 joystick may cause key sequences to appear and some keys will not function.
This is normal. Use the *SWAP* command or turn off emulation for port 1 to restore normal keyboard function.

SPECIAL EMULATOR FUNCTIONS

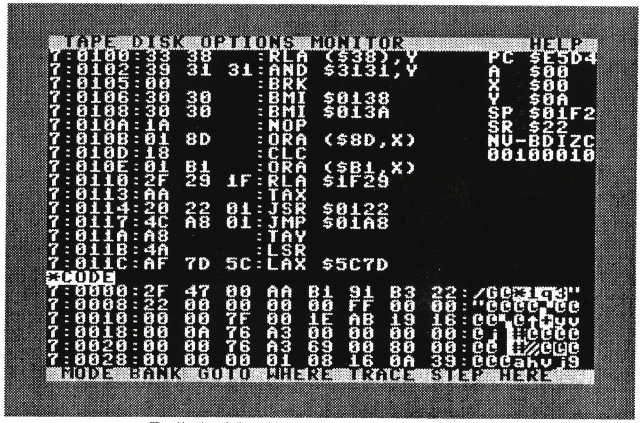
In addition to the Emulator Desktop, and the Commodore 64 functions, there are several functions unique to the emulator.

KEY OR SEQUENCE	SPECIAL EMULATOR FUNCTION
F9	Emulator Desktop
F10	Emulator Desktop/Joystick Configuration Shortcut
F11	Suspend Screen Updates (as long as pressed down)
ESCape	Exit Desktop/Cancel Function (including disk i/o)
CONTROL-BREAK	Exit to MS-DOS
CONTROL-ALT-DEL	Reset Commodore 64 (soft reset)
CONTROL-ALT-INS	Reset C64S Emulator (hard reset)
PRINT SCREEN	Take Screen Snapshot Saved to MS-DOS disk as a Windows 16-color BMP file. The files are automatically numbered for you.

COMMON MACHINE LANGUAGE ENTRY POINTS

SYS 64738	Reset Commodore 64
SYS 32761	Common ML Entry Point #1
SYS 32768	Common ML Entry Point #2
SYS 49152	Common ML Entry Point #3

MACHINE LANGUAGE MONITOR



Built-in Machine Language Monitor

The screen is divided in three parts, the largest part is the 6510 code area, the upper right shows you the 6510 registers and the bottom area displays a memory dump. Move around with the PgUp, PgDn, HOME, END, and arrow keys.

Data dumped at I/O addresses $D000 through $DFFF is the latest data written or read from the I/O address, it is not always what the CPU will read next.

Running C64 emulation in debug mode will cause a 30-50% slow-down. Exit debug mode by pressing ESC, once you have finished monitoring the programs.

MODE

Switches focus between CODE and DUMP

BANK

Selects memory bank
Banks 0-7 select a C64 bank (equal to low 3 bits of memory location $01)
Bank 8 selects emulated 1541 memory

GOTO

Prompts for a new address and JUMPS to it

FIND

Finds data in the memory dump bank. Data must be in hex, numbers longer than two digits are treated was word values and converted to LO/HI when searching.

WHERE

Moves code display to the instructions where emulation was interrupted.

TRACE

Executes one instruction and moves code display
Shortcut key is F7.

STEP

Steps over the instruction skipping code display of subroutine branches. In case of a subroutine call, the subroutine is executed in debug mode. You can interrupt subroutine execution by pressing ESC.
Shortcut key is F8.

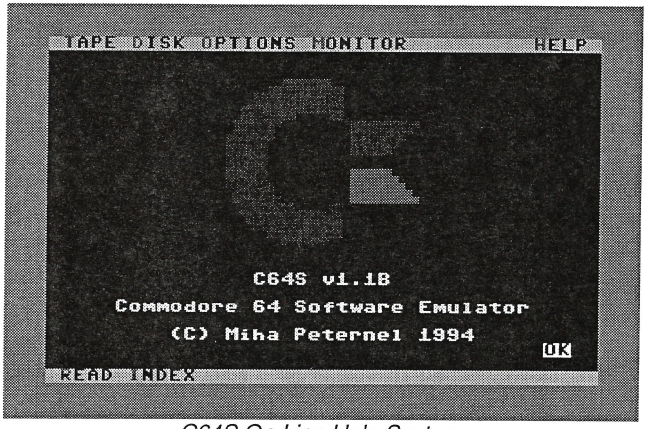
HERE

Sets a breakpoint at the position of code display and runs C64 emulation in debug mode until CPU reaches the instruction at the breakpoint or the ESC key is pressed.
Shortcut key is F4.

MCS6510 Microprocessor Instruction Set

ADC	Add Memory to Accumulator with Carry
AND	AND Memory with Accumulator
ASL	Shift Left 1 Bit (Memory or Accumulator)
BCC	Branch on Carry Clear
BCS	Branch on Carry Set
BEQ	Branch on Result Zero
BIT	Test Bits in Memory with Accumulator
BMI	Branch on Result Minus
BNE	Branch on Result not Zero
BPL	Branch on Result Plus
BRK	Force Break
BVC	Branch on Overflow Clear
BVS	Branch on Overflow Set
CLC	Clear Carry Flag
CLD	Clear Decimal Mode
CLI	Clear Interrupt Disable Bit
CLV	Clear Overflow Flag
CMP	Compare Memory and Accumulator
CPX	Compare Memory and Index X
CPY	Compare Memory and Index Y
DEC	Decrement Memory by 1
DEX	Decrement Index X by 1
DEY	Decrement Index Y by 1
EOR	Exclusive Or Memory with Accumulator
INC	Increment Memory by 1
INX	Increment Index X by 1
INY	Increment Index Y by 1
JMP	Jump to new Address
JSR	Jump to new Address Saving Return Address
LDA	Load Accumulator with Memory
LDX	Load Index X with Memory
LDY	Load Index Y with Memory
LSR	Shift Right 1 Bit (Memory or Accumulator)
NOP	No Operation
ORA	OR Memory with Accumulator
PHA	Push Accumulator on Stack
PHP	Push Processor Status on Stack
PLA	Pull Accumulator from Stack
PLP	Pull Processor Status from Stack
ROL	Rotate 1 Bit Left (Memory or Accumulator)
ROR	Rotate 1 Bit Right (Memory or Accumulator)
RTI	Return from Interrupt
RTS	Return from Subroutine (or exit to BASIC)
SBC	Subtract Memory from Accumulator with Borrow
SEC	Set Carry Flag
SED	Set Decimal Mode
SEI	Set Interrupt Disable Status
STA	Store Accumulator in Memory
STX	Store Index X in Memory
STY	Store Index Y in Memory
TAX	Transfer Accumulator to Index X
TAY	Transfer Accumulator to Index Y
TSX	Transfer Stack Pointer to Index X
TXA	Transfer Index X to Accumulator
TXS	Transfer Index X to Stack Pointer
TYA	Transfer Index Y to Accumulator

ON-LINE HELP SYSTEM



C64S On-Line Help System

The on-line help provides basic information the user needs when running Commodore 64S emulator. It is meant more like an on-line reference and not a copy of the manual.

USING HELP

DIRECTIONAL

Use the arrow keys to move around the topics
Use the `PgUp` and `PgDn` keys to list help screens.

READ

Press `ENTER` or `R` to jump to the highlighted topic

INDEX

Press `I` to get the help index

If you should get completely stumped, please call our technical support department at (206) 402-6003. You can also contact us through the following information services: *CompuServe, America On-Line,* and *Internet.* We also run our own support BBS.

CompuServe:	71202,560
America On-Line:	SeattleLab
Internet:	lab@seattlelab.com
Bulletin Board System:	(206) 402-6388
World Wide Web:	http://www.seattlelab.com

TIPS, TRICKS AND TROUBLESHOOTING

This is a collection of the most frequently asked questions regarding the Commodore 64-S emulator.

Question:
I selected a disk image file in the disk image screen. How can I use it?

Answer:
The emulated disk drive operates just like the original Commodore 1541 disk drive.

To display a directory type:
```
LOAD "$",8
LIST
```

To load a program type:
BASIC:
```
LOAD "programname",8 or
RUN
```

MACHINE LANGUAGE:
```
LOAD "programmname",8,1
SYS xxxxx
```
(where xxxx is the decimal entry address)

For more information see the "A CBM DOS PRIMER" section (Page 34).

* * *

Question:
My display does not show the entire Commodore 64 screen, why is that?
Answer:
Run the configuration utility (`CONFIG`) and set display mode to *compatible*. You must do this if you use a laptop computer with an LCD display.

* * *

Question:
How much conventional (base) RAM do I need for C64S to run?
Answer:
500K free, EMS (Expanded) and/or XMS (Extended) memory is not required.

* * *

Question:

When I press certain keys the emulator seems to dump random characters, arrows and numbers! Is this a bug?

Answer:

No. The original Commodore 64 acted in this manner as well. The Commodore 64 scans keyboard and joysticks at the same I/O addresses resulting in this side effect. To remedy this, enter the Joystick Option Screen (F10) and disable joystick emulation.

* * *

Question:

Keyboard joystick emulation is not working, what's going on?

Answer:

Try changing joystick emulation keys (F10, see page 18 for more details). Note that some keyboards behave strangely when certain multiple keys are pressed at the same time. If you notice that particular keys work fine when pressed one by one, but malfunction when pressed together, you must change the joystick emulation keys and find a combination that works with your keyboard.

* * *

Question:

I have difficulties using analogue joysticks, what can I do?

Answer:

Try recalibrating the joystick. Center the joystick trims and enter the Joystick Configuration Screen (F10, see page 18 for more details). If the emulator displays "Cannot Recalibrate" message, exit the emulator (CONTROL-BREAK), run CONFIG and check that the analogue joystick option is set to autodetect. If the joystick scanning mode is set to compensating, try setting it to compatible. When you change the joystick scanning mode, you also need to recalibrate joysticks in the emulator. If you are using a single analogue joystick, try assigning analogue joystick emulation to one port only.

* * *

Question:

Can I change emulation options and joystick options in the middle of a Commodore program?

Answer:

Yes. Simply enter the desktop (F9 or F10) and select the options you want and press ESC to return to your program.

* * *

Question:
Can I use my PC Printer with Commodore 64 programs?
Answer:
Yes, but only for pure text output. Printing graphics or changing text attributes will not work, because Commodore printers and PC printers use different sets of control codes. To use a PC printer, you must run `CONFIG` *and select the LPT (parallel) port where your printer is connected (the default is LPT1 which will work fine if you only have one parallel port, but you won't be able to use a Commodore disk drive at the same time.)*

* * *

Question:
Can I use my Commodore 1541 disk drive and/or Commodore Printer with Commodore 64 programs?
Answer:
Yes, any Commodore devices connected to LPT (parallel) ports can be used with emulated Commodore 64 programs. Run `CONFIG` *and check that use of external devices is enabled or set to autodetect. Please refer to page 6, "Configuration".*

* * *

Question:
How can I run the emulator from Windows, Windows NT, Windows 95 or OS/2?
Answer:
C64S can be run from Windows, Windows NT (Intel only), Windows 95 and OS/2 with sound ***disabled****. Windows 95 may require some performance adjustments (it's recommended that it be run in MS-DOS mode) to run under the desktop. It must be run full screen, and CPU emulation speed must be set to at least 200%.*

* * *

Question:
The DISK IO banner keeps blinking in the lower left corner, what is going on?
Answer:
The DISK IO banner appears when a Commodore program is running in emulated 1541 disk drive RAM (Commodore disk drives are intelligent, containing a CPU and their own RAM.), usually it's fastloader or protection code. If the banner keeps blinking but nothing seems to be happening, the program has probably crashed. Press `ESC` *to terminate DISK IO and then press* `CONTROL-ALT-INS` *to reset the emulator.*

* * *

Question:
How can I achieve the highest possible CPU emulation speed?
Answer:
Enter the General Options Screen (see page 16), set the CPU Speed to Maximum. Set Screen Refresh to Custom and enter the custom frame rate of 1/99. If the application does not use sprites, set show sprites to off. For more speed gains, try disabling analogue joysticks and/or sound emulation. Also, if possible, disable memory managers such as QEMM, EMM386, and 386MAX. If you are using Windows, or OS/2, try running C64S from MS-DOS (or MS-DOS mode if using Windows 95).

For improving game performance: Enter the General Options Screen (see page 16), set the CPU Speed to Maximum. Set Screen Refresh to Custom and enter the custom frame rate of 1/6 or 1/8.

* * *

Question:
I really do not like the borders, how do I disable them?
Answer:
Run the CONFIG utility and set display mode to compatible.

* * *

Question:
What is the best soundcard to be used for sound emulation?
Answer:
Advanced Gravis' Ultrasound card. It takes the least CPU time and produces the best output.

* * *

Question:
What do I do to listen to Commodore 64 music on a slow PC?
Answer:
Run CONFIG and check that sound synchronizing is enabled. Then run C64S and enter the General Options screen. First, set CPU Speed to original. Set Screen Refresh to synchronized and enter customer frame rate 1/10. Run the sound application, and then hold down F11. If reproduction seems to still be too slow, disable sound synchronizing in the CONFIG utility. If this does not help your computer is, unfortunately, too slow.

* * *

Question:
How do I transfer my 5.25" Commodore disks to the PC?
Answer:
Using the cable included with the full version of C64S, you can connect your Commodore 1541 or Commodore 1571 disk drive to your PC's parallel port (usually LPT1). Simply use our COM1541 software (included with your package) to make disk images or you can run your Commodore software right from your old Commodore drive. There are several shareware utilities available for transferring files as well. See the Transferring Files section on page 28 for more detailed information.

* * *

Question:
How do I find out about software upgrades and how do I get them?
Answer:
We do not have the facilities to notify each registered user of C64S. The best thing to do is to call, fax or write to us periodically. We run a BBS at (206) 402-6388 where program updates and other information is routinely posted. If you are active on Internet we post regular updates on the usenet newsgroup comp.emulators.cbm. Our e-mail address is lab@seattlelab.com and we have both an FTP and a world wide web server available at ftp.seattlelab.com and http://www.seattlelab.com.

* * *

Question:
What is planned for the next major release (version 2.0) of the emulator?
Answer:
Currently in development is full 1541 emulation, including support for copy protected software and fastloaders.

* * *

Question:
C64S isn't autodetecting my Pro Audio Spectrum sound card, how do I fix this?
Answer:
Check that the MVSOUND.SYS device driver is loaded in your CONFIG.SYS file. If you have installed Pro Audio Spectrum software properly the following line should be placed in your CONFIG.SYS

```
device=c:\spectrum\mvsound.sys  ...
```

(Note that the drive letter and directory for the driver may differ on your system.)
Consult your Pro Audio Spectrum user's guide for more information.

TRANSFERRING FILES

DISKETTES

COM1541

The COM1541 utility will let you transfer data from your Commodore 1541 (or compatible) floppy drive to "disk images" that can be used with the emulator. Each disk image takes up 170k on your PC so even the largest of Commodore software collections should be able to fit easily on most hard drives.

To run COM1541 you will need to do the following:

1. If you are running COM1541 for the first time, run `CONFIG` and set the 1541 port to your LPT port's I/O address.

2. Connect the PC's parallel port to the Commodore 1541/1571's serial port using the cable provided.

3. Run COM1541 by typing `COM1541` and pressing `ENTER`.

NOTE: If you are not running COM1541 from the emulator's home directory, you will need to use a switch to specify which port you are using. Use 1 for 278 (LPT1), 2 for 378 (LPT2) and 3 for 3BC (LPT3). For example: `COM1541 2` will try to connect using LPT2 at I/O address 378.

```
[D] Display Disk Directory
[I] Import full disk (fast mode, all sectors, all info)
[A] Import allocated sectors only (normal mode)
[F] Import full disk (normal mode, all sectors)
[X] Exit
```

The COM1541 Menu

DISK DIRECTORY

Displays the Commodore 1541/71's disk directory.

IMPORT FULL DISK

This requires a Commodore 1541 (it may not work properly with even a Commodore 1571) and uses a custom fastloader that works ten times faster than a regular transfer. In addition to copying all of the sectors on the disk (683 sectors total) it will also transfer sector error information (which is not currently implemented in C64S).

IMPORT ALLOCATED SECTORS

Only copies sectors marked as allocated in the Block Allocation Map (BAM) which is located on Track 18, Sector 0 on all Commodore disks. Probably won't work on most commercial games.

IMPORT FULL DISK

Copies all 683 sectors, as in *Import Full Disk* but without the extended information and at normal speed. This may take as long as a half hour.

EXIT

Returns to MS-DOS.

NOTES

After selecting a transfer method, COM1541 will prompt for a file name. If a file with the same name already exists it will be *overwritten.* The .D64 extension is automatically added, and if no filename is given the default filename of IMPORT.D64 is used.

ERRORS

An "RD Time-out" has to do with one of two things: Either your connection or the disk drive is faulty or the disk is not formatted on that side.

The transferring between the disk drive and the PC require a "bi-directional" parallel port. If all else fails you might want to pick up a new I/O card with this feature on it. Also some older PC's might not be able to handle even a bi-directional card. Until laser printers and other devices caught on, there was little need for bi-directional parallel communications.

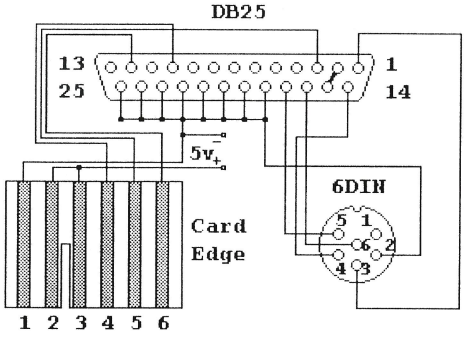
During the disk transfer if you see a "??" on the sector copy screen you'll see a message that there has been an I/O error and it is retrying. After the third time, it will **skip** the sector and continue. These are floppy errors on your Commodore disk. If you're using fast mode, try it again on normal mode. A last resort would be to use the *Import Allocated Sectors* method, and if that also fails you have a bad disk that may not be able to be transferred.

OTHER UTILITIES

The Star Commander and *Trans64* are two popular shareware "third party" diskette transfer utilities available. You can find them on the commercial on-line services The Internet, and many BBS systems.

CASSETTE TAPES

TAPE INTERFACE



DB25	6DIN	CARD
1	3	
2		
3		5
10		4
12		6
14	4	
15		
16	6	
17	5	
18-25	2	1 -5v
		2 +5v
		3 +5v

```
All connectors are viewed from the solder side.
DB25 is a male 25 pin DB.
6DIN is a male 6 pin Din.
CARD is a 6 trace card edge.
```

The Tape Interface Diagram

TAPEIO TRANSFER UTILITY

BACKGROUND

TAPEIO utility is actually a TurboTape compatible loader for the PC. The files loaded without errors are stored to a .T64 (tape image) file so they can be used within the emulator. To use it you need to connect a Commodore Datasette to the PC's LPT (parallel port). A VGA compatible display is necessary for graphic display of incoming tape data.

CONFIGURATION

The syntax for TAPEIO is:

```
TAPE IO [tapename[.T64]] [port]
```

If you are running TAPEIO from the emulator's home directory it will read the tape port selected with the `CONFIG` utility (default setting is LPT2 378). If you want to select a different port, you must specify it on the command line. Use 1 for LPT1 (278), 2 for LPT2 (378) and 3 for LPT3 (3BC). Run TAPEIO with no parameters to see the list of LPT port numbers. TAPEIO will not load anything if the port is not set correctly.

NOTE: If the specified tape image does not exist, TAPEIO will create one for you.

CALIBRATION

When you run TAPEIO, you are first resented with a record joustage screen. The border flashes and there is a red (dark) vertical line in the middle of the screen. Now press PLAY on the datasette. What you should see on the screen is the data coming from the datasette displayed as yellow graphics scrolling up. If the communications are working properly, the yellow graphics should form two jagged stripes. Now you can use *left* and *right* arrow keys to move the red line in-between the stripes. Use *up* and *down* arrow keys to change the display scale if necessary. This procedure is required to accommodate the loader to the speed of your computer. You can use a screw driver to adjust the tape head position in order to improve signal quality.

TRANSFER

When the red line is located as described as above press ENTER to start the loader. The loader will start searching for a file header. When a header is found, all the data is dumped onto the screen. When a file is being loaded, the border flashes in blue colors and the increasing percentage is displayed on the screen. This percentage tells the amount of the file already transferred. If the file is loaded with no errors it is added to the tape image file given on the command line. TAPEIO will continue loading files until the tape image directory is full (99 files) or it is interrupted by pressing ESC.

Press ESC at any time to exit TAPEIO and return to MS-DOS.

MAKETAPE UTILITY

If you transfer files using the shareware X1541 utility or if you download from a FTP site or a BBS, you will probably get the files in the raw Commodore 64 format (probably with the *PRG* extension). The files have a two byte start address followed by the program itself. MAKETAPE allows you to create empty tape image files and import raw C64 files. In addition to that MAKETAPE also imports .P00 files.

The syntax is:

```
MAKETAPE [filename[.T64]] [file1] [file2] [file3] ...
```

MAKETAPE first checks to see if tapename.T64 already exists. If it does, it opens the file otherwise it creates a new one with the name specified. If the tapename is succeeded by filenames, MAKETAPE adds each file listed to the end of the tape image.

Example:

```
MAKETAPE myprogs joke.prg mygame.prg speedscr.prg
```

THE INTERNET

The Internet has become a great resource for the "reborn" Commodore 64 enthusiast. Several world-wide-web pages and FTP sites have sprung up. This section is designed to give you a starting point for exploring the Commodore 64 resources on Internet. Please note that Seattle Lab is not affiliated with nor do we endorse any particular service or product. This data may change at any time. Also keep in mind that Internet is a global electronic community not regulated by any central agency.

COMMODORE 64 RESOURCES ON INTERNET

USENET NEWSGROUPS

comp.emulators.cbm	Commodore 64 Emulators
comp.binaries.cbm	Commodore 64 Programs
comp.sys.cbm	Commodore 64/128 Systems

FTP SITES (File Transfers)

frodo.hiof.no
ftp.giga.or.at

WORLD WIDE WEB

http://www.engr.wisc.edu/~conover/c64.html
http://www.hut.fi/~msmakela/cbm
http://www-ia.hiof.no/~ingemli

INTERNET RELAY CHAT (IRC)

#c64 Commodore 64 Channel

TECHNICAL INFORMATION

COMMODORE DISK DRIVES

AN OVERVIEW

Model	1541/1571*	2031	4040	8050	8250
DOS version(s)	2.6/3.0	2.6	2.1/2.7	2.5/2.7	2.7
Drives	1	1	2	2	2
Heads per Drive	1	1	1	1	2
Storage Capacity	170K/340K	170K	340K	1.05MB	2.12MB
Buffer Storage (K)	2	2	4	4	4
Tracks	35/70	35	35	77	77
Sectors per Track	17-21	17-21	17-21	23-29	23-29
Bytes per Block	256	256	256	256	256
Free Blocks	664/1328	664	1328	4104	8266
Location of Directory	18	18	18	38/39	38/39
Directory Entries	144	144	144	224	224
Transfer Rate (K/s)					
internal	40	40	40	40	40
IEEE/serial bus	0.4	1.8	1.8	1.8	1.8
Access Time (ms)					
Track to Track	30	30	30	5	5
Average Time	360	360	360	125	125

* The Commodore 1571 has two operating modes. One is a 1541 "mode" and the other was designed for the Commodore 128. C64S does not support the "128" mode (which uses both sides of the disk simultaneously).

A CBM DOS PRIMER

BASIC COMMANDS

LOAD

```
LOAD "program name",8    for BASIC programs
LOAD "program name",8,1  for Machine Language programs
```

SAVE

```
SAVE "program name",8    Save
SAVE "@:program name",8  Replace
```

RUN

```
RUN                      runs a BASIC program
```

SYS

DIRECTORY

DISPLAYING

```
LOAD "$",8
LIST
```

PRINTING

```
LOAD "$",8
OPEN 4,4:CMD 4:LIST
PRINT#4:CLOSE 4
```

SELECTING

To display, for example, just sequential files:

```
LOAD "$:*=S",8
LIST
```

WILDCARDS

The standard * and ? wildcards are active in CBM DOS.

"Splat Files"

You may occasionally see a file in a directory listed similar to this:

```
0      "MONOPOLY"              *PRG
```

This is a file that had an error occur during a write. The safest way to remove this is with the VALIDATE command.

THE COMMAND CHANNEL

To open a command channel (to talk to CBM DOS) simply type in the following:

```
OPEN 15,8,15
```

The first 15 is a file number, and could by any number between 1 to 255. It is used to match the secondary address, which is also 15. The middle number is the primary address, better known as the device number, and is normally 8 when talking with the 1541. A second disk drive would be 9, a third would be 10, and so on.

INTIALIZE

```
OPEN 15,8,15
PRINT#15,"I0"
CLOSE 15
```

VALIDATE

```
OPEN 15,8,15
PRINT#15,"V0"
CLOSE 15
```

Use with caution, some games (e.g. Loderunner) will not work after you use this command.

FORMAT

This is not supported in C64S.

RENAME

```
OPEN 15,8,15
PRINT#15,"R0:new name=old name"
CLOSE 15
```

SCRATCH (ERASE)

```
OPEN 15,8,15
PRINT#15,"S0:filename"
CLOSE 15
```

COPY

```
OPEN 15,8,15
PRINT#15,"C0:new file=old file"
CLOSE 15
```

NOTE: This does not copy between devices.

DIRECT PROGRAMMING

BLOCK-READ (U1)
BLOCK-WRITE (U2)
BLOCK-ALLOCATE (B-A)
BLOCK-FREE (B-F)
MEMORY-READ (M-R)
MEMORY-WRITE (M-W)
MEMORY-EXECUTE (M-E)

This section will be expanded when these commands are supported in full.

CBM DOS REFERENCE

ERROR MESSAGES

NUMBER	DESCRIPTION
00	OK
01	FILES SCRATCHED Track number shows how many files were removed
20	READ ERROR (Block Header Not Found)
21	READ ERROR (No Sync Character)
22	READ ERROR (Data Block not Present)
23	READ ERROR (Checksum Error in Data Block)
24	READ ERROR (Byte Decoding Error)
25	WRITE ERROR (Write/Verify Error)
26	WRITE PROTECT ON
27	READ ERROR (Checksum Error in Header)
28	WRITE ERROR (Long Data Block)
29	DISK ID MISMATCH
30	SYNTAX ERROR (General)
31	SYNTAX ERROR (Invalid Command)
32	SYNTAX ERROR (Command Line > 58 Characters)
33	SYNTAX ERROR (Invalid Filename)
34	SYNTAX ERROR (No File Given)
39	SYNTAX ERROR (Invalid Command)
50	RECORD NOT PRESENT
51	OVERFLOW IN RECORD
52	FILE TOO LARGE
60	WRITE FILE OPEN
61	FILE NOT OPEN
62	FILE NOT FOUND
63	FILE EXISTS
64	FILE TYPE MISMATCH
65	NO BLOCK
66	ILLEGAL TRACK AND SECTOR
67	ILLEGAL SYSTEM T OR S
70	NO CHANNEL AVAILABLE
71	DIRECTORY ERROR
72	DISK FULL
73	DOS MISMATCH (Returns DOS Version)
74	DRIVE NOT READY

READING THE ERROR CHANNEL

```
INPUT#15,EN(Error Number),EM$,ET,ES
```

VARIABLES: Error Number, EM$ = Error Message, ET = Track, ES = Sector

NOTE: COMMAND CHANNEL must be open

DISKETTE ORGANIZATION

TRACK NUMBER	SECTORS	SECTORS
1 to 17	0 through 20	21
18 to 24	0 through 18	19
25 to 30	0 through 17	18
31 to 35	0 through 18	17

DISK DIRECTORY (Usually starts at Track 18, Sector 0)

BLOCK ALLOCATION MAP (BAM)

BYTE	CONTENTS	DEFINITION
0,1	18,01	Track & Sector of first directory block
2	65	ASCII Character A Indicating 1541/4040 format
3	0	Unused
4-143		Bitmap of available blocks for tracks 1-35 (bit on = available)

DIRECTORY HEADER

BYTE	CONTENTS	DEFINITION
144-159		Diskette Name padded with shifted spaces (ASCII 160)
160-161	160	Shifted Spaces
162-163		Disk ID
164	160	Shifted Space
165-166	50,65	ASCII Representation of 2A. DOS Version/Format Type
167-170	160	Shifted Spaces
171-255	0	Unused

DIRECTORY STRUCTURE

BYTE	DEFINITION
0,1	Track and Sector of next directory block
2-31	File Entry 1
34-63	File Entry 2
66-95	File Entry 3
98-127	File Entry 4
130-159	File Entry 5
162-191	File Entry 6
194-223	File Entry 7
226-255	File Entry 8

FILE ENTRY STRUCTURE

BYTE	DEFINITION
0	File type ORed with $80 to indicate properly closed file. If ORed with $C0, file is *LOCKED* ***TYPES:*** *$80 ORed with DEL(0), SEQ(1), PRG(2), USR(3), REL(4)*
1-2	Track and Sector for first data block
3-18	Filename Padded with Shifted Spaces (160)
19-20	REL files: Track and Sector of first side sector block
21	REL Files: Record Length
22-25	Unused
26-27	Track and Sector of replacement file (@SAVE or @OPEN)
28-29	Number of blocks in file LO/HI

FILE STRUCTURES

PRG (Programs)

Usually used for BASIC and Machine Language programs

FIRST SECTOR

BYTE	DEFINITION
0,1	Track and Sector of next block in file
2,3	Load Address of Program (LO/HI)
4-255	Next 252 bytes of program. BASIC is tokenized.

NORMAL SECTORS

BYTE	DEFINITION
0,1	Track and Sector of next block in file
2-255	Next 254 bytes of program. BASIC is tokenized.

FINAL SECTOR

BYTE	DEFINITION
0,1	A null followed by the number of program bytes in block
2-???	Final bytes of the program. BASIC ends with three nulls. Any excess bytes are ignored.

SEQ (Sequential Files)

Usually used for text files or simple databases

FIRST/NORMAL SECTORS

BYTE	DEFINITION
0,1	Track and Sector of next block in file
2-255	Next 254 bytes of data.

FINAL SECTOR

BYTE	DEFINITION
0,1	A null followed by the number of program bytes in block
2-???	Final bytes of data. Any excess bytes are ignored.

USR (User Files)

See PRG (Program Files); "User defined" structure but generally follows the Program structure.

DEL (Deleted Files)

Usually a dummy entry to help organize the directory listing. Many times it's simply a horizontal "line".

REL (Relative Files)

DATA BLOCK

BYTE	DEFINITION
0,1	Track and Sector of next data block.
2-255	Next 254 bytes of data. Empty records contain $FF in the first byte followed by nulls to the end of the record. Partially filled records are also padded with nulls.

SIDE SECTOR BLOCK

BYTE	DEFINITION
0,1	Track and Sector of the next side sector block
2	Side Sector Number (0-5)
3	Record Length
4-5	Track and Sector of Side Sector 0
6-7	Track and Sector of Side Sector 1
8-9	Track and Sector of Side Sector 2
10-11	Track and Sector of Side Sector 3
12-13	Track and Sector of Side Sector 4
14-15	Track and Sector of Side Sector 5
16-255	Track and Sector Pointers to 120 data blocks

BETWEEN SECTORS: THE 1541/4040 FORMAT

Sync Mark
Header Block ID
Header Block Checksum
Sector Number
Track Number
ID Character Number 2
ID Character Number 1
Byte: $0F
Byte: $0F
Header Gap
Sync Mark
Data Block ID
256 Data Bytes (User-Readable Area)
Data Block Checksum
Byte: $00
Byte: $00
Inter-Sector Gap

COMMODORE 64 ARCHIVES AND LIBRARIES

There are four major compression/archiving formats in the Commodore 64 realm. One of the most popular is LYNX which uses a .LNX extension. This format is not compressed but is a way of creating a single file from many. There are many versions (some conflicting) of LYNX. Library is very similar (usually .LBR or .LIB). ZIP (not to be confused with *PKZIP*) is a compressed disk archive. A ZIP is broken into four files (and then usually LYNXed) the names are usually 1!filename 2!filename and so forth. There is a utility called *ZIP2D64* which converts these to emulator disk images. Lastly is ARC, which is the old SEA archiver. It is horribly slow on the Commodore 64 and not widely used.

There are no utilities at this time to convert LYNX or LIBRARY files directly to disk or tape images.

TAPE AND DISK IMAGES

TAPE IMAGES

T64 FILE STRUCTURE

OFFSET	SIZE	DESCRIPTION
0	64	Tape File Record
64	32*n*	File Records for *n* directory entries
64+32*n*	???	Binary Contents of File(s)

T64 FILE RECORD

OFFSET	SIZE	DESCRIPTION
0	32	Header String (ends with a $26 (EOF))
32	2	Tape Version ($0101)
34	2	Number of Directory Entries
36	2	Number of Used Entries
38	2	Unused
40	24	User Description

DISK IMAGES

D64 FILE SIZES

SIZE	TRACKS	DESCRIPTION
174848	35	Standard Disk Image
175531	35	Extended Disk Image (683 bytes for error map)
196608	40	Standard Disk Image
197376	40	Extended Disk Image (768 bytes for error map)

NOTE: Version 1.1C and earlier of C64S only supports the Standard type 1 format.

D64 FILE STRUCTURE

OFFSET	SIZE	DESCRIPTION
0	256	Sector in raw format

Sectors for this purpose are numbered 0-682.

THE FUTURE

Being developed now is a new disk image format designed to accommodate GCR encoding, fastloaders, copy protection, compressed data and other features.

WORLD WIDE DISTRIBUTION

Seattle Lab Inc.
ATTN: C64 Order Processing
9606 Northeast 180th Street
Bothell, WA 98011
U.S.A.

We offer three versions of C64S. The full package is $69.95 which includes: the full version of the emulator on 3.5" high density diskette, a 4-foot cable that allows you to connect a Commodore 1541 or Commodore 1571 disk drive to your PC, a printed copy of this manual, free technical support and upgrades (via our FTP site, our World Wide Web service and our BBS). C64S "Lite" Is $64.95 without the cable, but includes the rest of the package. The third is "C64S E-Lite" for e-mail users who don't need or want the cable, the price for it is $59.95 worldwide. There are no shipped components, as delivery is entirely done via electronic mail. Encoding schemes that are available are UUENCODING, MIME and BINHEX. We accept payment in U.S. funds only, shipped products outside of North America must include an additional $5.00 for shipping and handling. We ship U.S. mail first class, please allow 1-3 weeks for delivery for U.S. orders and 2-6 weeks for overseas orders.

Phone:	206/402-6003
FAX:	206/828-9011
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WWW:	http://www.seattlelab.com
BBS:	(206) 402-6388

NOTE: Once you buy a 'non-cable' package, we cannot sell you a cable separately.

We accept orders from all over the world except for *Germany* and *Slovenia.*

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